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NEW YORK SUGAR MARKET.

RAWS.—The firmness noted in the raw sugar market last week has continued throughout the week under review, resulting in a further advance of 1-16c. per lb., to 3¾c. duty paid, under transactions to a large extent during some days. The market continued firm up to the close, on this basis, although there is rather more disposition on the part of refiners to buy sugars for shipment rather than for spot delivery. This is perhaps because the receipts for the week having increased to 33,105 tons, against 9,810 tons during the preceding week, while the meltings increased only from 16,000 tons to 20,000 tons for the week. The news from Washington is such that it is now quite likely that the reciprocity bill with Cuba will pass the Senate before calling an extra session and this expectation is influencing the market in two ways, or rather three ways. The refiners having increased their immediate supplies, are less disposed to pay 3¾c. for spot Centrifugals, but are willing to pay full cost and freight prices for shipment. On the other hand the Cuban planter is stimulated to hold his sugars on the treaty prospect and to ask even higher prices on the cost and freight basis, although willing to sell his nearby cargoes at the current quotations duty paid. Thus, while we can look for no further duty paid advance, for the present, we can confidently expect an increased cost and freight value directly ahead. This will inure to the benefit of the planters, inasmuch as their sales this season for future delivery have been comparatively small, so that whatever benefit comes from a reduction in duty is very sure to go into their pockets. This will go far to put our neighboring Republic on a firm financial basis in another 12 months. The fact that the United States markets are now nearly ¼c. per pound lower than the European markets is a sufficient guarantee against any very material decline, as already mentioned by us last week, the markets of the United Kingdom being open to receive supplies from the British West Indies at any greater difference in price.

REFINED.—The strength of the raw market and its advance further reduced the difference between raw and refined to a point where it became necessary for the refiners to take some action, which they did during the week, to a moderate

extent, by raising the list price of refined 5c. per 100 lbs. This, however, is inadequate to meet the situation, and, if other conditions were satisfactory, a further advance might be anticipated, but, with the Arbuckle refinery still quoting 5c. per 100 lbs. less than other refiners, and with a still continued unsettled condition of the grocery trade, there is always danger of private cutting on all sides below the posted rates, and this we feel is what is occurring now from day to day, making it extremely difficult to say exactly where the refined market stands. However, each refiner appears disposed to protect his customers on the lowest basis made by any, when final settlement day arrives, so that all orders are in the end treated exactly alike from whatever source they come, or in whatever condition they may be taken. It is hoped that, eventually, some way may be found out of the present refined sugar tangle, so that all public posted prices can be relied upon, which has not lately been the case. There seems to be no reason why buyers should not continue to carry a fair line of stock.

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DR. MAXWELL IN QUEENSLAND.

From our Australian exchanges, it appears that Dr. Maxwell does not meet with that cordial cooperation which he should receive to insure success in his efforts to improve agricultural operations in Queensland. Like every other reformer his methods are blocked by men who prefer the old methods to the new and more profitable. The Queensland Sugar Journal says: It is not our intention to unnecessarily mix ourselves in the controversy which appears to be raging, in a one-sided sort of fashion, between Dr. Maxwell and some of the Bundaberg people, but it is clearly our business, as representing, as far as possible, the opinion of sugar producers in all the Australian districts, to place our readers *au fait* with what is being said. Dr. Maxwell, if one can believe all that is said by that paper, is doing nothing, and discontent concerning him is rife in the sugar districts. Now first of all it must be clearly understood that our Bundaberg contemporary cannot presume to speak for the whole of the sugar districts of this State. Dr. Maxwell is doing double analysis of the soils, a thing not done in this country before, so as to discover not only the plant food in the lands, but also the proportion of that food available for the use of the crops. As a matter of fact he has made greater progress with his work in Queensland, with its varying conditions and immense distances, than he was able to do during his first few years in the comparatively compact and homogeneous sugar areas of Hawaii.

THE TRUTH ABOUT CUBA.

Becoming displeased, apparently, at the delay of our Government in granting Cuba the reciprocal tariff concessions as advocated by Cuban "sympathizers," President Palma is reported to have recently given utterance in Havana to this pertinent phrase: "Cuba will thrive whether America aids her or not."

The truth of these words, which but express the knowledge that most fair minded Americans have all along felt concerning the so-called necessity to give aid to Cuba, should have much bearing on the coming fight in Congress over the same question that occupied most of the time of the last session and proved barren of results—reciprocity, and our duty to the Pearl of the Antilles, whose people have been given freedom at the cost of our blood and treasure.

We are told that European influence is being brought to bear upon the newly formed republic, given existence through the munificence of the United States, which influence is seeking to divert the Cuban trade to other sources. This courting of favor by representatives of foreign governments has evidently caused President Palma to forget the attitude he so lately occupied as a suppliant for relief at the hands of the United States Congress, and in an unguarded moment, perhaps, feeling his oats, as it were, he gave utterance to the words quoted above, which should be made the shibboleth of the anti-Cuban reciprocity party, when the Cuban bill again comes before Congress.

The dispatch referred to, conveys the information that when the time comes, if come it will, for the Cuban executive to sign a reciprocity treaty with the United States, that President Palma will be so pledged to foreign governments that he will insist on the insertion of a clause that reserves to him the right to extend the benefits of similar treaties with Great Britain and her colonies, Mexico, Germany, France, Spain, and the Latin American republics. Such an agreement, if carried out, seems to make the cause of the domestic sugar industry more secure, for the Cuban reciprocity bill will thereby be made all the more difficult to pass.

Let it be remembered that "Cuba will thrive whether America aids her or not."—La. Planter.

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IRRIGATION, BEET SUGAR AND RECIPROCITY.

The most gigantic enterprise ever undertaken by any government is the irrigation problem of the United States. Few have any idea of the scope and significance of the work carried on by the office of the experiment stations of the United States Department of Agriculture. The investigations made by this office are not limited to the arid regions alone, but

also cover the sub-humid and humid regions, and even extend to the newly acquired island possessions.

Irrigation and sugar beets, are two closely connected factors, especially in the arid belt. Only by the help of irrigation is it possible to raise sugar beets in the arid regions. With such help, however, there is no section in this country that will produce such high sugar contents and weight as the irrigated region. It is no exaggeration to say that irrigation is the strongest ally of the beet sugar industry, and that this ally will make the arid belt, or at least that part which is amenable to beet culture, the great sugar storehouse of the United States. Moreover, in the favored sections, sugar beets will be the principle staple crop grown.

One of the most enthusiastic advocates of irrigation is President Roosevelt. He is, therefore, perhaps unwillingly, one of the most active promoters of the American beet sugar industry. But while Uncle Sam, and with him the present occupant of the presidential chair, is thus engaged in strengthening a domestic industry by irrigation, Uncle Sam, in the person of the same occupant, is equally strenuous in favoring Cuban, or rather Sugar Trust reciprocity, which would largely destroy the chances of the beet sugar industry. He gives with one hand and takes with the other. But while what he gives will benefit an immense number of Americans, what he attempts to take in the alleged interest of Cuba will benefit one corporation only, which exists in violation of the Sherman anti-trust law.

There is something ludicrous and at the same time pathetic in this situation. It is a riddle to the objective observer how the public power, organized for the protection of all interests, can justify its interference for the benefit of a law-breaking corporation, to the detriment of a large number of independent producers. It is absolutely incomprehensible how the same man can favor irrigation for the benefit of the domestic producer and then make reciprocity speeches in favor of the Sugar Trust.

There seems to be only one plausible explanation. Reciprocity with a special reduction on refined sugar of a certain color, if accomplished, will enable the Sugar Trust to import this Cuban sugar at an immense profit and to compete the present beet sugar manufacturers out of existence. This done, the Sugar Trust can invade the irrigated region and control also the beet sugar section in this country. Only through this explanation is it possible to get any system into what would otherwise be an inexplicible—absent-mindedness. —Beet Sugar Gazette.

DANGER OF FOREST FIRES.

In the West Indies, and elsewhere in the tropics, under the generic term of bush fires are included all those conflagrations, both great and small, whether caused purposely or accidentally, that destroy the vegetable products of the soil. They may be divided into five classes as follows:—

1. The fires deliberately set to burn down plants growing on limited areas with the object of destroying blights that are troublesome or are likely to become epidemic.
2. The fires sometimes made to the windward of cultivated lands affected by insect blights, so that the dense smoke may kill or drive away the pest.
3. The "burns" when high forest is cut down, the trees lopped, and fire is used to destroy the immense encumbering mass of wood so as to render the ground sufficiently clear for cultivation.
4. The "grass fires" that are set in dry seasons to destroy dry rank grass in order to induce a new and tender undergrowth for the grazing of cattle or for the grasscutter's knife.
5. The ordinary "bush fires" of Dominica and other mountainous countries, by means of which the soil is cheaply and expeditiously cleared of brush and weeds (cut down or hoed up) on lands intended to be put into cultivation.

The first class of fires is simply a method adopted in the treatment of diseased plants, and is one of the heroic remedies of the plant physician when he endeavors to stamp out a dangerous epidemic. Such a remedy, however, is never used without careful precautions being taken to prevent unnecessary damage.

The second class of fires differ from the first in that the cultivated plants are not destroyed. The plan is frequently employed in some countries to rid plants of insect pests which are readily killed by the acrid smoke of burning green wood, bush and leaves.

The third class of fires are seen only in forest clearings where they are made use of to remove the massive tangle of fallen trees that encumber the ground. In the early years of settlement in the West Indies, when the islands were covered with primeval forests, these "burns" as they used to be and still are called, were part of the systematic work of all planters. Laborie, in his well-known work entitled *The Coffee Planter*, gives particular directions as to the proper way in which the forest trees should be felled and the branches lopped and strewn, so as to get what he describes as a "good burn" that will clear the land sufficiently for commencing cultivation. It is worthy of remark, however, that even this far-seeing writer, who penned his words over a century ago, deplored the destruction of certain constituents of the soil by these fires, and said "it is to be wished that burning could

be dispensed with." Forest burns are now to be seen only in Dominica, St. Lucia, Trinidad, Jamaica and other islands in which there are still tracts of virgin forest; and, as such fires are essential and not fraught with dangerous consequences, if due care be taken to prevent the conflagrations spreading, it is unnecessary further to consider them than to point out that legislation should not prohibit them, but should impose an obligation on the planter to prevent destruction of standing forest around the clearings.

The fourth class, or grass fires, are frequently seen in all the islands more especially in dry districts. As I shall later on have occasion to show, these fires—which often take place every dry season on the same ground—are disastrous in their ultimate effects, and the crop of fresh grass that springs up after them does not compensate for the evil worked.

The fifth class comprises the ordinary and well-known bush fires of the tropics. They are especially common in Dominica, and, in the dry season, they may be observed in that island in all directions. Indeed, not only the peasants but also many proprietors of large estates invariably employ this wasteful method of clearing land for cultivation. The advocates of the system say that the fire gets rid of the brush and weeds expeditiously and cheaply, and some say that it also does lasting good by destroying the harmful insects on the soil. It may be conceded at once that vegetable matter is removed most easily by fire and if the removal of this matter were the only consideration no voice could be raised against bush fires. But a serious question has to be answered in the first instance, namely, is this vegetable matter in the form of leaves and brush of so little use to the land and the planter that its destruction is desirable? And, following on this question is the equally important one, does the planter gain or lose by converting all his organic material into inorganic matter in the form of ashes? Both of these questions I hope to answer in such a way as to show that the clearing of land by fire is the worst and most wasteful system that the planter could adopt. I would pause here, however, to say a few words about the erroneous idea that, in consequence of fire having been passed over the land, there is likely to be a long immunity from the depredations of insects for the reason that all of them have been destroyed in the burnt area. Now, most insects, like the higher animals in a state of nature, wander about in search of food. They are kept in check by natural laws, the chief of which is the struggle for existence. And it is futile to expect that a circumscribed area can be kept free from insects by passing fire over it, for, as soon as fresh vegetation springs up on the burnt land, the insects will find it out and come in from all sides, so that in a short time the insect

population of the patch will be as numerous as it was before the fire was set.

The harmful effects of these bush fires on the soil may be thus tabulated:—

They destroy nitrogenous matters that would have gone to enrich the soil by the natural decay of the brush and leaves.

They destroy a certain proportion of the nitrogenous matters already in the upper layers of the soil.

They destroy the nitrifying microbes in the upper layers of the soil.

They sterilize the upper layers of the soil, and thus, for a time, prevent the fixation of nitrogen for the use of vegetation.

It may be roundly asserted that in all cultivated soils in the West Indies there is a deficiency of nitrogenous constituents, which deficiency is usually attempted to be made up by the application of manures or by the digging in of plants, more especially those of the pea family, grown on the land for the purpose. It is therefore most essential that the planter should do everything possible to add to his soil all the vegetable matter he can get hold of, so that, by its decay, it may increase the deficient nitrogenous constituents. And yet it is the custom in Dominica and elsewhere to destroy these most valuable organic materials by fire, instead of turning them into the land to repay the expense and labor of so doing over and over again by the resulting increased crops and finer produce. Indeed, as I have said elsewhere, "To prevent the peasant from destroying what is necessary for the fruitfulness of his land, is to do him good by ensuring larger crops from his holding. Thus it is advantageous to the country generally that this wasteful destruction by fire of important constituents of the soil should be put an end to." Agricultural chemists tell us that every pound of nitrogen in the soil has a definite value which may be expressed in figures. Were it possible to calculate the annual loss to planters on the basis of the money value of the nitrogen robbed from the soil by the bush fires, the total amount would be astounding.

But these bush fires not only destroy the vegetable matters intended by nature to enrich the soil, but they burn or bake the upper layers of the land, and this means that not only does the heat of the fire volatilize the nitrogenous matters already prepared in the soil for the assimilation of plants, but that it also destroys the nitrifying microbes that are constantly at work to produce the rich organic material for further plant food. Thus it seems that fires on lands, especially in these countries, are utterly disastrous in many ways, that they cause a diminution of the quantity of the produce got from the soil, and therefore deleteriously affect

the fortunes of the planters and consequently the prosperity of the country.

To prohibit these fires entirely would be to prevent peasants and others from destroying what is necessary for the fruitfulness of the land and so it would be sound political economy. But political economy and "the liberty of the subject" are sometimes contradictory terms, as in this instance in which a man is held to have as much right to destroy the fruitfulness of a certain portion of the land as he has to pull down his house. But he must confine the destruction to his own property and not injure his neighbor's. Were these bush fires always limited to the circumscribed areas being cleared for cultivation there would be less to be said against them, and it is questionable whether, in the present state of public opinion repressive legislation could be suggested with any chance of its adoption. But by carelessness, by ignorance, and, sometimes, with malicious intent, the conflagrations spread over and ravage large tracts of land, thereby destroying much valuable property.

The devastation caused by bush fires in Dominica alone is enormous, and it is undoubtedly a serious drag on the prosperity of the island. During the dry seasons the fires may be seen in all directions along the coast, in the valleys and on the hills. The absence of all control has rendered the people quite reckless in regard to them. If a peasant has to clear a few square yards of land to plant some "ground provisions," he will set fire to the dry bush in the afternoon and then gaily go home without troubling as to where the fire may run to. A fire set in this way in Dominica, not very long ago, near to the sea, spread to neighboring lands and produced a conflagration that raged for days, running up a wide valley, destroying everything in its path and then reaching and seriously damaging cane and lime plantations on the hills. Dominica planters will tell the tale of how their cargo and other plantations have been greatly injured and the crops ruined by fires carelessly set in contiguous peasants' holdings; and they will tell also how their woodlands have been destroyed by similar fires. Indeed the losses due to these constantly recurring fires have become so great that legislation is urgently needed. If the matter were carefully inquired into, it would be found that, year by year, an increasing extent of land is being rendered barren by bush fires. As an illustration of the correctness of this statement I may bring forward the following facts concerning certain districts along the leeward coast of Dominica. Many years ago there were thriving coffee plantations on these lands, but now they are barren wastes of rocks covered in places with a thin skin of soil. During the wet season rank grass and weeds spring up from seeds dropped by birds or blown by the wind. Were the land left to itself, by the operation of natural laws

soil would accumulate and seedling trees would grow and increase in number and variety, and, in a comparatively short time in our West Indian climate, a "secondary forest" would result, and then, by the judicious felling of a portion of the wood, the land could be gradually brought back to cultivation. But what really happens is that most of these waste lands are subjected to the ravages of bush fires every year, the seedling trees are killed out and the soil is left burnt and bare with no live roots ramifying in all directions to hold its particles together, so that, when heavy rains come, the loosened surface soil is washed to the valley or sea, and nothing but a rocky barren waste remains. This disastrous destruction of a cultivable soil has been going on for years and years in many islands in the West Indies, and it has resulted in the conversion of former fertile districts into barren wastes in Dominica, Montserrat, Antigua and all the islands to the north. It has not only made deserts where there should be gardens, but it has actually in places produced a disastrous effect on the climate. Mr. Watts can tell you of the evil effects of bush fires at the northern end of Montserrat and throughout Antigua. And I doubt not that many here can bear testimony to the fact that I have not over-estimated the urgency of the question.

In Dominica there is a dry, barren district known as Grand Savannah, and, years ago, the late Dr. Imray endeavored to reclaim a portion of it by planting young Ceara rubber trees on it in all directions. The plants grew well and there was every hope that this barren waste would have been brought into remunerative cultivation, and that a new industry would have been established in the country; but, unfortunately, the bush fires set by the peasants in the dry season swept over the plantation and killed out the rubber trees planted with so much care and expense. A similar attempt made later on to plant up portions of the Grand Savannah met with the same disappointing result, and it is clear that nothing can be done in Dominica to reclaim such barren lands until, by legislative enactments, the people are prevented from causing these extensive and disastrous conflagrations.

Legislation is also, undoubtedly greatly needed in many islands to abate the evils caused by these bush fires. It would not be advisable now to prohibit all fires on lands, but, without delay, an end should be put to the system whereby every person can, at any time, with impunity set fire to dry grass and brush and so produce a conflagration that may, and often does, cause great injury and loss to his neighbor's property, and that certainly retards the prosperity of the country. Although bush fires need not be prohibited altogether, they should not be allowed to be set in very dry seasons as they are then exceedingly dangerous; and, at other times, they

should be so regulated that the evils I have brought to your notice may be mitigated if not entirely abolished.—*West Indian Bulletin.*

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THE ROOT ROT OF TARO.

[From an interesting pamphlet, By T. F. Sedgwick of the Hawaii Agricultural Experiment Station, we make some extracts regarding this plant.]

According to DeCandolle the taro plant is a native of India; from which country it was transported first to Ceylon, Sumatra, the Malay Archipelago and Egypt, and more recently to the Fiji Islands and New Zealand. From New Zealand it undoubtedly accompanied the present native Hawaiian race in its migration to Samoa, Tahiti, and finally to these Islands.

The plant has been in cultivation so long that there are many cultural varieties, differing from one another in size, maturity, form and habit of growth, and especially in the coloring of the flesh of the swollen root or corm, the portion of the plant which is mainly used for food, and the varieties resulting from cultivation have become so fixed, that they now have nearly the same value as separate species.

In Hawaii there are two distinct individual strains of taro, the one with red or pink flesh and the other white. Of each of these strains there are many sub-varieties or forms, each with native names. A list of such varieties is given in "Thrum's Annual for 1888," enumerating twenty-eight in all. Later lists give as high as forty-five separate forms or strains known to the Hawaiian people. * * *

Taro holds about fourth place among the products of Hawaii, at least in area of land devoted to its cultivation and probably also in total value of crop. The investment in taro growing approximates from $450,000 to $500,000. It is practically all consumed in Hawaii, the export of taro flour or "Taroena," amounting to but a very small percentage of the total crop.

Taro cultivation is exceedingly profitable, and land suited to its cultivation, provided it has water rights, brings a high annual rental. The average rental per acre in the vicinity of Honolulu for taro land ranges from $40 to $50. The average retail price of poi in Honolulu ranges from 2½ to 5 cents per pound. One acre will generally produce from twelve to fifteen tons, which sells for from $1.75 to $2.50 per hundred pounds. Land taro, or taro grown without irrigation, makes excellent poi and does not seem as readily affected with the root rot as that grown under irrigation.

The land suitable for the cultivation of the water taro, the variety which is principally grown, is a rich deep, muck soil,

bordering the streams or occupying the lowest portions of the valleys extending back into the mountains. Land to be capable of growing taro must have an abundant supply of running water, and it needs also to be very rich. Many of the taro fields now in cultivation have been planted in taro, with hardly any rest for one hundred years or more. The old Hawaiians understood the needs of occasional fertilizing and often allowed their patches to go without a crop for one season. They also planted certain weeds or burs in the taro patches, and spaded under the growth, thus not only giving the patch a rest, but adding a considerable amount of organic matter to the soil.

The available irrigated taro land is about all occupied. The opening up of new areas for its cultivation would be dependent, either upon the discovery of additional sources of water supply, or upon more careful use of the water now available.

Although taro has been the staple food of the Hawaiians, it is probable that the demands for it and its products will decrease rather than increase as time goes by. Taro and its products while relished by many of the older white settlers of these Islands does not meet the same favor among the newer population, so the probabilities are that the time will come within the next one or two generations when a large share of the taro lands now in cultivation will be planted to other crops.

Usual Method of Culture.—Taro is cultivated in patches of varying size. Each patch is surrounded by a dyke containing openings admitting water and allowing its exit. These patches are usually extremely irregular and depend on the contour of the land both as to size and shape. A valley containing one or two square miles will have, perhaps, two or three hundred taro patches or fields, and hardly two of these will be exactly alike in size or shape.

Before planting the taro the water is allowed to drain off the fields; the ground is then dug up, or plowed with a rice plow, and is fertilized with the leaves, stems and trimmings of the previous crop. In this way the taro rot is perhaps often transferred to new fields, through the use of the trimmings of diseased plants as fertilizer. Occasionally stable manure is used, or rarely, a complete fertilizer. These are thoroughly mixed with the soil.

Taro is propagated by means of the crown of the plant with its accompanying leaf stalks. At the time the crop is harvested, the upper portion of the root is cut off with a knife, then the leaves themselves are cut off leaving about six inches of leaf stalk on the crown of the root. These tops, called "hules," are either planted in a circle around a little mound of dirt, or in rows across the field. They are usually placed about one foot apart. As soon as the patch is planted water is again turned on, but only enough is used to keep the

hules moist until the roots start. The patch is not flooded.

In about a month after the hule has been planted the roots start, and the crown throws out new leaves. The period of maturity varies according to the variety, ranging from twelve to fourteen months or more, from the time the hule is set in the ground.

Cultivation consists in keeping the patch clear of weeds and the soil between the roots is sometimes stirred with pick or shovel, care being taken not to loosen the roots. * *

TARO ROT.—The lowland taro, or that which is grown entirely under irrigation, suffers a great deal from a disease known as "taro rot." This rot has assumed such proportions that many taro growers have been compelled to give up the cultivation of this crop and use their lands for rice, bananas or other crops. In the vicinity of Honolulu, it is estimated that this rot, in average years, causes a loss of half the crop. Certain districts are apparently free from the disease, but it has been reported from all of the Islands of the group.

The disease appears to be of two forms, one of which is due to soil conditions or lack of drainage. The other is of a fungus or bacterial nature and is due in part at least to the planting of diseased hules. The rot is first observed in the patches when the plants are about two months old, usually making its appearance on small or poorly nourished hules, or on those which are improperly planted. The disease is entirely local."

The losses throughout the Hawaiian Islands due to the disease amounts to at least $70,000 per annum, and the disease seems to be on the increase.

The high rental value of the lands, and present methods of cultivation of taro work against the adoption of rational methods of combating the rot. With a crop which requires from twelve to fourteen months for its complete maturity, the cultivator feels that he must have something growing on the soil during the entire term of the lease, and a crop of taro is no more than harvested before another is planted, sometimes not more than three or four days intervening between the harvesting of the crop and the replanting of the hules. * *

SUMMARY.—Plants affected with the rot are easily distinguished in the field, either by the stunted appearance of the plant, or by the unusual bluish green or yellowish color of the leaves. The lower portion of the corm and the fine feeding-roots which anchor the corm in the soil, are rotted away, and if an effort is made to pull up the plant it comes very readily.

The first diseased plants in the experimental plat were found four months after planting, but in some of the adjoining plats not under supervision, the rot appeared at two months. The first hules found to be diseased were small and very badly developed, and were found to have been cut with

very little of the mother taro left, or in planting they were bent or not put in deep enough, or else they were found in stagnant water. By comparing the experimental plat with the adjoining ones it could readily be seen that the fertilizer retarded maturity. That is, taro grown where no fertilizer had been applied, had a tendency not only to contract the disease, but also to mature in a very much shorter season. Some of the adjoining plats which were not fertilized, had to be harvested six months before the proper time, because of the prevalence of the rot. These facts indicate that proper fertilization at the right time, is one of the chief remedies or preventatives of taro rot.

Practical experiments have shown that taro grows best if the hules are planted on virgin soil. In most patches, the taro grown on the margin of the field is the best, especially that which is next to the dyke, the soil of which the dyke is formed probably containing more plant food than the mud at the bottom of the patch. There is also usually better drainage immediately adjacent to the dyke than in the center of the field.

It has been observed that where taro is planted on virgin soil, or on land which has either been allowed to rest for three or four months, or has been planted in rice or some other crop, the plants will remain healthy for several seasons. The growing of rice on taro land is an effective remedy for taro rot, giving comparative immunity for two or three years, but the liming of the soil will be found more practicable.

Observations made during the past season indicate that the disease is carried only to a limited extent by the irrigation water. The experimental plat was comparatively free from this disease this year, although during the previous season it had been seriously infected. The next plat below was this year badly attacked by the rot, but the second plat into which the water drained was comparatively free from it. This local infection demonstrates, that although the soil may be thoroughly impregnated with the disease, yet the plants, if they are primarily healthy, will resist rot to a greater degree than if primarily weak.

The hules used in the experimental plat were chosen from plants badly infected with the rot, and the fact that a number of plants with rotten roots were found within the first six months, would indicate how the disease is spread.

The conditions in the experimental plat previous to the beginning of the experiment were the worst that could possibly be obtained in that locality. The crop harvested in 1901 was very badly diseased, and the hules from this crop were used in the experiment, but with all these adverse conditions, the yield from the experimental plat has been greater than in any similar area in the Kalihi District, being at the rate of 16 tons to the acre. This is much above the average.

In the experimental plat the disease appeared first on the hules which were small and weakly, many of which had been planted. A diseased plant matures sooner than a healthy one, and may have healthy looking leaves, but they are mostly dwarfed and more or less distorted. The root will develop and take on the form of an apparently matured root six months before it should do so. The taro root rot is apparently a local disease. A single diseased plant may be found among many healthy ones, or there may be a limited area in which every plant is infected.

The disease attacks the plant in two ways, and seems to present two stages of development. In one case the taro root rots from the tip. The decay gradually extends upward until the whole corm becomes a soft decayed mass. A root infected with this soft rot has a peculiar characteristic fetid odor, something like decayed fish. The other form of the disease apparently has its source in the center of the corm, or near the lower end, and the effect is to produce a hard, brown core. This may be an entirely distinct disease from that commonly known as root rot.

A diseased slip will grow better on virgin soil, or soil which has been planted to other crops, than on old taro soil. Harvesting taro before its maturity has a tendency to induce disease. The planting of one variety year after year on the same patch, tends to a deterioration of the crop. The development of the rot seems favored by allowing the water to become stagnant, the taro growing best in running water. In irrigating the taro patches the water should be made to circulate over the entire plat. The usual method is to admit the water at one corner of the patch, and to have the outlet on the same side at the other corner. As a result the water stagnates over two-thirds of the field.

Hules which have no eye are often planted. These are slow to start and are more liable to become diseased. Plants growing on soil which has not been sufficiently dug up and cultivated, produce poor taro.

In applying fertilizer to a taro soil, it should be done before the taro is planted, and thoroughly mixed with the soil. The field shouuld then remain unplanted for as long a period as possible and be again cultivated before the hules are planted.

Fertilizers promote the growth both of diseased and healthy plants. Where there was an excess of lime in certain spots, a few plants were corroded by it, but there was no disease.

Nitrogen, in the form of ammonium sulphate or of sodium nitrate is the only fertilizer which can be profitably applied to taro while it is growing.

Conclusions.—The conditions necessary to secure a good crop of taro, are:

(1) A supply of good hules free from disease.

(2) A patch so laid out as to secure the most economical use of the irrigation water.

(3) The application of proper fertilizers at the right time.

(4) A constantly running stream of water circulating over the fields, or when this is not possible, a frequent change of water.

(5) An occasional change in the variety of the taro planted.

(6) An entire change of hules from one patch to another, or a rotation of crops, using taro land for rice or bananas, at least two years in every five.

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INSECTICIDES FOR USE IN HAWAII.

One of the greatest hindrances to agriculture in these Islands is the ravages of insect pests. The songs of the ancient Hawaiians often refer to the roses once grown, but the roses exist today only in song and in the memory of Kamaainas. Their growing was abandoned because of the destructive work of the Japanese "rose" beetle (*Adoretus umbrosus*).

Watermelons and muskmelons are a luxury, a good watermelon bringing fifty cents to one dollar at the fruit stands in Honolulu. These products could be raised in certain sections, in quantities great enough to bring them within the reach of every table, were it not for the attack of the "melon-fly" (*Dacus cucurbitae*).

Some sections, otherwise ideal for farming, cannot produce paying crops because of the presence of vast numbers of cutworms, locally known as "peelua" or "poko" worms, the young or larvæ of several species of moths belonging to the family Noctuidæ, which devour not only the vegetable gardens but whole fields of forage plants.

One of the plant lice, the "green fly" (*Aphis* sp.), in the past season did much damage to the corn crop of the Kula District, on the Island of Maui. The yield of corn would have been large, but the attacks of the plant lice may result in driving many holders to give up their leases. It is not the small farmer alone who is the sufferer. The manager of one of the sugar plantations estimates a loss of $50,000 worth of cane on a single plantation through the destructive work of the cane borer, the larva of a beetle (*Sphenophorus obscurus*).

Mention should be made of the valuable work of Prof. A. Koebele, the Territorial entomologist, who has not only greatly benefitted these islands, but other countries as well, by the introduction of beneficial insects into infested regions. The lack of this natural check, (the insect enemies of injurious insects), greatly increases the percentage of loss through insect depredations. The introduction of such beneficial species will, when they become established, help to solve the problem of Hawaii's insect pests, but cannot be relied upon to exterminate the pests or render the use of insecticides unnecessary.

PRECAUTIONARY MEASURES.

Vegetable gardening in the vicinity of the larger towns is at present the only side of horticulture developed within the Territory. No large orchards or vineyards exist. Hawaiian agriculture is confined mainly to the production of field crops. The raising of fruits is for the most part limited to a small number of trees about the homes.

Generally speaking, the measures taken in combating the injurious insect pests of field crops must be precautionary, an effort to prevent their becoming established rather than attempting a remedy afterwards. But when a pest is established, and its work is serious, the use of insecticides is in many cases feasible.

The "balance of nature" in these Islands is, at present, decidedly in favor of the insect pests. Thorough cultivation of crops, rather than cane, has not been practiced; varieties of plants especially resistant to insect attacks have not been chosen; the proper time of planting has not always been taken into account; certain necessary elements, which the plants need for food, have been lacking in the soils, and, except in the raising of cane, have not been supplied by fertilizers. Insect pests have crept in upon us from abroad unobserved, leaving their enemies behind. There are no regular seasons of extreme cold or dryness, and thus relieved of natural checks the pests have multiplied rapidly. All these factors have turned the balance in favor of the pest. Every effort must be exerted to reverse the balance in favor of the plant. A good strong healthy plant will often show no serious effects from an attack by insects where a weak or poorly fed plant will be completely devoured. Clean cultivation; the burning of all rubbish about cultivated fields, which may harbor insect pests; planting at the time attacks are known to be less serious; and, using fertilizers to supply in abundance the necessary elements of plant food, will tend to make strong healthy plants which in many cases will withstand insect attacks and thus render the use of insecticides unnecessary.

GENERAL USE OF INSECTICIDES.

The practice of fighting insect pests by the use of insecticides has come into general use throughout the world. Both the entomologists and horticulturists of the U. S. Department of Agriculture at Washington and the various State experiment stations, have given much attention to the subject. The result is an immense amount of scientific literature, much of which is within the reach of the ordinary reader. Detailed instructions covering the use of the more important insecticides, applying to the United States in general, are given in Farmers' Bulletin 127 of the U. S. Department of

Agriculture, by C. L. Marlatt, First Assistant Entomologist, and the formulæ for the various insecticides given in the present bulletin are taken from this and other similar publications.

BITING AND SUCKING INSECTS.

The injurious insects attacking the external parts of plants may be placed, in accordance with their manner of feeding, under two general heads:

(1) Biting insects—those that injure vegetation by actually biting and eating the plant, (Fig. 1).

(2) Sucking insects—those that injure the plant by piercing the outer covering or epidermis, and, by means of tube-like mouth parts, sucking the sap or juice from the tissues of the plant, (Fig. 2, B).

The idea in the use of insecticides is to apply various poisons in such a way as to cause the death of the insects. In the case of *Biting* insects the poison is an *internal* one, that is, the poison is applied to the food of the insect so as to be eaten with it, thereby causing its death. To kill the *sucking* insects the poison must be applied to the insects themselves, acting as an *external* irritant, since they do not chew the plant, and, therefore, will not take in the poison placed on the surface. The poisons used for sucking insects must kill by contact alone, and this class of insecticides is spoken of as the "contact" poisons. In no case must the remedy be worse than the disease, that is, it must not kill or seriously injure the plants while killing the pests.

The biting insects common in the Hawaiian Islands may be illustrated by the Japanese beetle, the cut-worms (peelua or poko worms), grasshoppers, the Olinda bug (*Aramigus fulleri*), and others with biting mouth parts. Figure 1, illustrates the work of the biting insects.

The sucking insects are represented by the mealy bugs, scale insects, plant lice, and plant hoppers. In figure 2, B, the effect of the attack of a sucking insect is shown.

Insects of both classes feeding on the external parts of the plant, offer a fairly easy problem of control. Those feeding on the internal parts of the plant, such as the cane borer and melon-fly, or on the roots of plants beneath the surface of the ground; various household pests; and insects living as parasites on domestic animals, present more difficult problems, and therefore demand special treatment in combating them.

SPRAYING APPARATUS.

The most common method of applying insecticides is by spraying. A liquid poison, to kill either by being eaten with

the food or by contact with the insect itself, is "sprayed" on the infested plants. Nearly every manufacturer of pumps has on the market apparatus made expressly for this purpose. These range all the way from a hand syringe (Fig. 5, A.) with a capacity of a few ounces, to steam or gasoline sprayers (Pl. I., Fig. 3) with a capacity of several barrels. The important parts of any spraying device are a pump to force the liquid out through a hose, and a nozzle (Fig. 5, C.) at the end to convert the liquid into a spray.

Where the plants are of any height, trees for example, the nozzle must be brought in close proximity to the parts to be treated, since the liquid cannot be thrown any great distance. This is done by means of a handle of some light material, usually bamboo. (Note extension rods shown in illustrations Pl. I.)

SUCCESSFUL SPRAYING.

Successful spraying depends mainly on four things: (1), understanding the feeding habits of the insect, that is, whether it is a biting insect or a sucking insect; (2), the nature of the remedy to be applied; (3), the efficiency of the apparatus to cover the infested part of the plant; and, (4), the thoroughness with which the work is done. The frequency of showers in many localities in the Territory will make it necessary to spray more often than elsewhere.

In cold countries the pests receive a natural check by the severe winters, and much of the spraying is done at the time when the plants are not in the leaf, since there is then no danger of damage to the foliage. However as insect pests find here in Hawaii a continuous supply of food, it will require a more persistent effort to keep them in check.

INSECTICIDES.

Spaying Mixtures for Biting Insects.

(Beetles, cut worms, grasshoppers, and others with biting mouth parts.)

Paris green:—

Paris green	pound.	1
Lime	pound.	1
Water	gallons.	100-250

To prepare this mixture slake the lime in 2 or 3 gallons of water and dilute to the desired strength. Mix the Paris green into a paste with a little water and stir into the lime mixture. The stronger mixtures are used for such vigorous foliage as

that of the potato, the weaker mixtures for tender foliage, such as that of the peach. An average of 1 pound of Paris green to 150 gallons of water is a good strength for general purposes. The lime is added to combine with free arsenic which may be present and thus to remove or lessen the danger of scalding the foliage. The mixture should be strained before use to prevent lumps from clogging the spraying apparatus and should be kept constantly stirred or shaken to prevent settling. Apply by means of a pump, spraying the plants until they are evenly covered, but stopping before the mixture commences to drip from the leaves.

Paris green	pound	½
Bordeaux mixture	gallons	40-50

Bordeaux mixture is used to check the fungus diseases of plants. It is often used with success in combination with Paris green. Such a mixture has the advantage of not being readily washed away by showers, and plays a double part in destroying not only the insect pests, but the fungus diseases as well. This mixture is especially recommended for potatoes here and should be applied early, even before the effects of the cut worms and the fungus disease to which this crop is subject are to be seen.

Paris green has for years been the standard remedy for biting insects, such as cut worms, beetles, grasshoppers, etc., but on account of its high price and the difficulty of keeping it in suspension several other arsenical poisons have been recommended as substitutes for it under certain conditions, among these being arsenate of lead and arsenite of lime.

Arsenate of lead:—

Arsenate of soda	ounces	3
Acetate of lead (white sugar of lead)	ounces	7
Water	gallons	25

The arsenate of soda and acetate of lead should first be dissolved separately in a few quarts of warm water, using wooden vessels. When dissolved, mix together and dilute to the required proportions. When the two solutions are mixed a white precipitate of arsenate of lead is formed which is more easily kept suspended in water than any of the other arsenical poisons.

Arsenate of lead is now on the market, both as a dry powder and in paste form, ready for immediate use. It "may be used at any strength from 3 to 15 pounds to the 100 gallons of water without injury to the foliage, and in this respect is much safer on delicate plants than any other arsenical. Its use is advised where excessive strengths are desirable or with delicate plants where scalding is otherwise liable to result.

With this insecticide there is an advantage in using the freshly prepared and wet mixture in that it give a more filmy and adhering coating to foliage, the same fineness not being secured when it has been dried and repulverized."

There is danger of this poison being mistaken for something harmless, because of its lack of color, and for this reason a dye is often added to prevent accident.

Soda Arsenite of lime:—

White arsenic	pound..	1
Sal Soda crystals	pound..	4
Water.	gallons..	1

Boil the arsenic and the sal soda in the water for twenty minutes, or until dissolved. Add enough water to make up for the loss by evaporation. This is the stock mixture and will keep indefinitely, but, in all cases must be diluted greatly before using. For ordinary spraying operations add one pint of the stock mixture to 40 gallons of water, in which about three pounds of freshly slaked lime has been previously mixed. If used with the Bordeaux mixture the lime addition is to be omitted, using as before, one pint of the stock arsenical mixture for 40 gallons of the Bordeaux mixture. The arsenic unites with the lime to form arsenite of lime. The soda is used to hasten the process and to insure the combination of all the arsenic with the lime. The greatest care should be exercised in preparing the stock mixture, and afterwards in keeping it plainly labeled to prevent its being mistaken for some other substance. In actual practice the arsenite of lime has proved as effectice as the older arsenical compounds. Its cost is very inconsiderable, which, with its known effectiveness, is its chief recommendation.

Pyrethrum:—

Pyrethrum or buhach, is the powder commonly used here against mosquitoes, by burning. "It acts on insects externally through their breathing pores, and is fatal to many forms both of biting and sucking insects. It is not poisonous to man or the higher animals, and hence may be used where poisons would be objectionable. Its chief value is against household pests, such as roaches, flies, and ants, and in greenhouses, conservatories, and small gardens, where the use of arsenical poisons would be inadvisable. . . It is used as a dry powder, pure or diluted with flour, in which form it may be puffed about rooms or over plants."

Pyrethrum is also applied in water in the proportion of one ounce of the powder to two or three gallons of water.

Hellebore:— . .

White Hellebore is an internal poison used against biting insects. Its use is limited because it soon loses its poisonous properties on exposure to the air, and is comparatively high in price. It is also less active than the arsenical poisons. It is recommended for use in the treatment of plants the fruits of which are to be eaten shortly. The powder should be applied in the evening or morning, when the plants are wet with dew, or just after a shower. Applied with water use one ounce of hellebore to three gallons of water and apply with a spray pump.

Dry Application of Paris Green.

Paris green	pound..	1
Flour or lime	" ..	10

Mix together thoroughly and apply with a powder gun or sack. Many forms of powder guns are on the market. A dusting sack can be made from any cloth material having an open mesh and the application is made by shaking the bag lightly over the plants.

The application of insecticides in dust form is strongly recommended by some writers. Over limited areas and on low-growing plants it can be done effectually, especially in the early morning or late evening when the dew is present to cause the poison to adhere better to the foliage. Marlatt says: "For application to vegetables which will ultimately be used for food, as the cabbage, 1 ounce of the poison should be mixed with six pounds of flour or ten of lime and dusted merely enough to show evenly over the surface. Arsenicals should not be applied to the lettuce or other vegetables the free leafage of which is eaten."

Lime may replace the flour in the mixture, but it does not adhere to the plant so readily, and is less readily eaten by the insect.

In reply to an inquiry as to the importance of dust spraying as practiced in Missouri and adjacent States, Prof. J. C. Whitten, Horticulturist of the Missouri Experiment Station, writes as follows: "The dust spraying is assuming considerable importance with us where men have large orchards and have not the water or teams to spray with the great weight of water that is necessary in large orchards. It is particularly in favor in the rough fruit lands of the Ozarks where the steep hillsides and large areas make liquid spraying expensive and in some cases impossible.

In our judgment it is not generally so effective as liquid spraying where the latter can be thoroughly done but where one cannot spray with liquid it is way ahead of no spraying.

The following data in spraying for codling moth of the apple in our experimental orchard last year gives something of an idea of how it compares with liquid.

Check trees, not sprayed; fruit had 72 per cent affected with moth.

Dust sprayed trees had 36 per cent affected with moth.

Liquid sprayed trees had 16 per cent affected with moth.

In both cases Paris green was used to kill the moth, it being applied with air slaked lime as a dust and in the regulation way with water as a liquid spray."

At present Hawaii has no large orchards but should this line of agriculture become important, as it undoubtedly will in time, the results of the Missouri experiments will be well worth bearing in mind. Much of the land which might be used for fruit raising, especially fruits of the temperate zone, is found in the higher altitudes, where liquid spraying would be a difficult matter on any considerable scale because of the prevailing steep slopes.

Poisoned Baits.

The attacks of certain kinds of insects, such as the cut worms, are often most effectively checked by the use of various poisoned baits.

Arsenic and bran mash:—

White arsenic	pound	1
Sugar	"	1
Bran	"	6

Mix with just enough water to moisten the mass.

A dry mixture of bran and Paris green has been recommended for the cut worms. In either case place the mixture in rows in infested fields. Do this even before the pests put in an appearance. Frequent rains will make it necessary to repeat the operation. Care must be taken to keep domestic animals out of fields treated in this manner.

Another poisoned bait recommended by several authorities is freshly cut plants, such as sorghum, cabbage leaves, alfalfa, etc., dipped in a strong arsenical mixture and strewn about in infested places. The bait should be protected from drying by covering with boards or stones, and should be renewed as soon as it becomes dry, or every 3 to 5 days. For insects such as cut worms, which work at night, the baits should be applied in the early evening so as to be as fresh as possible.

Spraying Mixtures for Sucking Insects.

(Scale insects, mealy bugs, plant lice, etc.)

This class of insect pests is widely distributed and occurs in large numbers throughout Hawaii. The most important insecticide for the sucking insects is kerosene emulsion.

Kerosene emulsion:—

The keresone emulsion used in recent trials made by this station was prepared in the following manner:—

One-half pound of whale-oil soap was dissolved in one gallon of water while the water was boiling over a fire. While the solution of soap and water was still boiling hot it was removed a safe distance from the fire and two gallons of kerosene (coal oil) was added and the mixture thoroughly churned together with a force pump (Fig. B) by pumping the mixture back into itself, using a nozzle throwing a direct stream. The emulsion was churned in this manner for about five minutes or until it had become creamy and all the free oil had disappeared.

This is the stock solution and in all cases must be diluted before it is applied to the insects on an infested plant. The emulsion thus made kept well for several weeks. If the oil separates from the mixture it will rise to the top and should be skimmed off before the emulsion is applied. Any hard soap shaved fine may be used in place of the whale-oil soap.

The emulsion should not be diluted until wanted for use. The amount of water added to dilute the stock solution depends on the pest to be destroyed; that is, whether it is a "hard" or "soft" bodied insect. The soft-bodied insects are well illustrated by the mealy bugs and the plant lice. The bodies of the scale insects are covered by a hard waxy excretion which resists the action of the emulsion or other insecticides. A strength of 1 part of the emulsion to 20 parts of water was sufficient to kill the aphis on rose bushes and cucumber vines; 1 part of the emulsion was added to 15 parts of water and used with success against the mealy bug on citrus trees. The powdery or "mealy" excretion of the wax-like substance with which this insect is covered necessitated using the stronger solution (15 to 1, instead of 20 to 1). In some cases a second spraying was necessary to kill all of the mealy bugs, probably because the emulsion did not injure the eggs. A second spraying about ten days after the first application, if done thoroughly, will entirely clear the plants of the mealy bug. In case of the "purple" scale of the orange, and the "rose" scale, a strength of 1 part of emulsion to only 10 parts of water was found necessary to kill the insects.

Since the emulsion kills only by actual contact with the

insect, it is absolutely necessary that each insect be covered by the emulsion in order to destroy all.

A small quantity of the emulsion can be made from the following formula and applied to plants where the number to be treated is small, as in a dooryard, by such a sprayer as shown in Figure 7.

Cook's hard soap emulsion:—

"Dissolve one-fourth of a pound of hard soap—or whale-oil soap—in two quarts of water, add one pint of kerosene oil, and pump the mixture back into itself while hot. This always emulsifies at once, and is permanent with hard or soft water. This is diluted with twice its bulk of water before use." This small amount can be agitated or emulsified with an egg-beater, if a force pump or syringe is not available.

Kerosene and water are often applied by means of a spraying apparatus which mixes them automatically in the desired proportions, thus doing away with the necessity of an emulsifying medium such as soap. There are several such pumps on the market.

The following caution in regard to the use of kerosene emulsion or other oil washes is taken from Farmers' Bulletin 127: "In the case of kerosene washes, and, in fact, of all oily washes on plants, the application should be just sufficient to wet the plant, without allowing the liquid to run down the trunk and collect about the crown. Usually around the crown, in the case of young trees at least, there is a cavity formed by the swaying of the plants in the wind, and accumulation of the insecticide at this point, unless precautions be taken, may result in the death or injury of the plant. Under these conditions it may be advisable to mound up the trees before spraying and firmly pack the earth about the base. Care should be taken in refilling the tank that no free oil is allowed to accumulate gradually in the residue left at the bottom, when spraying with emulsions or oil-water mixtures."

Whale oil soap—

Whale oil soap	Pound	½
Water	gallon	1

Dissolve the soap in hot water and apply while still warm with a spray pump. A solution of the above strength will be effective against plant lice and other soft bodied insects. For scale insects a stronger solution (2 pounds of soap to 1 gallon of water) is required. There is danger of a strong solution injuring the foliage and since here in Hawaii the plants are always in leaf such solution should be used with caution. "With large trees, or badly infested trees, preliminary to treatment it is desirable with this as well as other applications to prune them back very rigorously. This results in an economy of spray and makes much more thorough and effective work possible."

Resin Wash—

Resin	pounds	5
Caustic soda (crude 78 per cent)	"	1
Fish oil (whale oil soap)	"	½
Water	gallons	20

Place the resin and soda, "with the oil, in a kettle with water to cover them to a depth of three or four inches. Boil about two hours, making occasional additions of water, or until the compound resembles very strong, black coffee. Dilute to one third the final bulk with hot water, or with cold water added slowly over the fire, making a stock mixture, to be diluted to the full amount as used. When sprayed the mixture should be perfectly fluid, without sediment, and should any appear in the stock mixture reheating should be resorted to, and in fact the wash is preferably applied hot."

This wash is generally used on trees in a dormant condition, that is, trees which have shed their leaves and are undergoing a period of rest. The lack here in these Islands of a definite period of rest on the part of the trees will necessarily restrict the use of this wash.

Gas Treatment.

Treatment with certain gases has been found to be very effective in destroying insect pests. In applying this method it is necessary that the plant be placed in an air tight room (as for nursery stock) or covered by a tent. Carbon bisulphide and hydrocyanic acid gas are the two gases most frequently used.

Carbon bisulphide—

Ants may be killed by first making holes in the nest and pouring into each about an ounce of carbon bisulphide and closing the holes with earth.

Plant lice on small plants may be killed by placing an ounce or more of the carbon bisulphide in a dish under the plant and covering the plant with an air tight box.

This substance is used with great success against insect pests infesting stored grain. It is poured on the top of the grain in bins, or a small room, more or less air tight, at the rate of 1 pound to 1 ton of grain or 10 cubic feet. The gas is heavier than the air, and for this reason will sink into the mass. Marlatt says: "The bisulphide may be more freely employed with milling grain than that intended for seeding, since when used excessively it may injure the germ."

Carbon bisulphide is expensive when purchased from retail druggists by the pound. It can be purchased from whole-

sale houses in 50 pound lots or more for about 10 cents per pound, the buyer paying the freight charges.

Attention should be "called to the danger from fire in the presence of carbon bisulphide vapor in the air, but special reference should be made to it in connection with the treatment of buildings. It is customary to mention the danger of bringing a lighted cigar or any such thing into the presence of the fumes. The application should always be made in daylight as no artificial light of any kind is allowable." The same care should be exercised in the handling and storing of carbon bisulphide as is customary with other high explosives.

Hydrocyanic acid gas—

This gas, used extensively in certain sections of the country for scale insects, is generated by adding potassium cyanid to a mixture of water and sulphuric acid. The proportions depend on the space the gas is to occupy. This is a violent poison, and since the fruit industry is not at present developed to any extent here, further information is not demanded.

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HOW TO SUCCEED IN BUSINESS.

In an admirable article in the American Grocer, we find the following advice to young men starting in business, by Thomas Martindale, one of the leading merchants of Philadelphia:

The openings for young men of small means are just as numerous here as they are in any other country, but they are not labeled and tagged. The man who is looking for them must be able himself to recognize them. If he waits for them to come to him, with unimpeachable letters of introduction, and a certificate that they are of the clear quill, he will probably be disappointed.

There are openings in plenty for men of discernment and ability, but very few for the dullard or "has been;" for on this coast are congregated, without a doubt, the brightest, keenest traders in the whole country—young, active, daring, enterprising, public-spirited, and right up-to-date. This is the kind of competition that is to be met. It is a common saying that every line of business is over-done. It is not so. It is the cry of those who are not able to adapt themselves to the new conditions. There may be some lines—groceries, restaurants and the like—that are over-done, but it is only the poor ones of these that are complaining. Those that are conducted in a business-like way are making money.

There are in this country hundreds of opportunities to be seized, and worked out, that nobody yet has seriously considered. Success or failure in any line, here or elsewhere, is in the way the thing is done. The man with limited capital should, first of all, study the situation himself, on the

ground. It he does this intelligently, and measures his abilities correctly, he need make no mistake.

I have an abiding faith in the integrity and honest judgment of President Roosevelt. A man who enjoys the woods, the mountains, and the prairies, as much as he does, and gets as much outdoor excitement as he does, ought to have clear judgment, a firm purpose, and good nerve. I'm a hunter of big game myself, and I can speak "by the book" of the beneficial effects on the reasoning powers of a vacation spent in the solitudes of the great coniferous forests, with the capture of big game as the sole magnet to draw me there, and keep me there until the vacation period expires. Then, and there, if a man ever can see the right and wrong of a problem, he will be sure to distinguish the right from the wrong with the greatest ease, because his mind is—or should be—unbiased by outside influences; and with no sounds to disturb his mental poise, excepting, perhaps, the soughing of the wind through the pine and juniper needles, and the spruce boughs —which only stimulate and freshen his reasoning powers—his brain should work at its best. Hear, then, what Theodore Roosevelt, the hunter, the President of the United States, has to say upon opportunities:

"In this country the one thing worth having is opportunity, coupled with the capacity to do well and worthily a piece of work."

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DANGERS OF ELECTRICITY.

How to Avoid Them.

By Sydney F. Walker, R. N., M. I. E. E., Etc., Etc.

The accidents at the Fulham baths illustrate the dangers incident to the use of electricity, and a consideration of them and others of a similar nature show how easily the dangers may be provided against.

Electricity is coming more and more into our daily life. It is entering more and more into all our manufacturing processes, and its use in every instance means either greater comfort or cheaper production. But there is one thing necessary in order that the increasing use of electricity may go on, and that is that it shall be produced and delivered to the consumer at a cheap rate, and for this purpose it is necessary that higher and higher pressures shall be made use of.

The Perils of High Pressure.— High pressures enable electricity to be generated at places where energy can be obtained cheaply and to be transported cheaply to where the consumer requires it; and it is not only the very high pressures, such as are used for transporting electricity in large quantities, that are economical. What may be termed high

domestic pressures enable current to be delivered to private houses, offices, warehouses, etc., at a cheaper rate than lower pressures, and this is the reason that in almost every town, as soon as incandescent lamp makers were able to produce a really practical lamp at 200 volts, the lighting service was altered to that figure. And this is where the danger comes in—a danger, however, easily guarded against.

When a man grasps a conductor with his hands and his feet are connected with what electricians call "earth," the other conductor of the supply service being connected to "earth" also, or when he grasps two conductors representing the two sides of the supply service with his two hands, a current passes through his body as long as he remains in connection. This current passes through the nerves controlling two of the vital organs, the lungs and the heart, and the danger will depend on the pressure of the service, the strength of the current which passes, and the time during which it passes, the last being one of the most important factors. The strength of the current passing will depend also on the pressure, and on the contact the victim makes with the supply service and with "earth."

The blood is forced through the arteries, the small capillaries, and the veins by the action of the heart. The heart is, in fact, a pump, and is subject to many of the laws governing other pumps. If anything occurs to stop or to lessen the action of the lungs, the action of the heart is lessened by the increase of the resistance to the passage of the blood through the vessels, and by the decrease of energy delivered to the heart itself. If this goes on for any length of time the heart must come to rest, as any other pump would.

And that is what takes place when an electric shock is received, either from hand to hand or from hand to feet. If the shock is very powerful the heart may stop at once. If it is not very powerful, but if the passage of the current continues for any length of time, the heart may come gradually to rest, and this is what seems to have taken place at Fulham and in other cases.

Some Recent Accidents.— I have investigated several instances of death from electric shock during the past few years, where the pressure was supposed to be safe, and would have been safe with very trifling precautions.

The conditions in all the cases were the same. There was an electric service of either 500 volts continuous current or 200 volts alternating. The victims in each case were making good connections with "earth" through their feet and other portions of their bodies. They made conections with a conductor in which there was an electric pressure by grasping another conductor which was in connection with the supply conductor, through a break in the insulating envelope. The connection was in nearly every case for several minutes at

least. At a mine in Warwickshire the victim was standing on wet ground, in wet boots and stockings, the ground being in connection with one side of the 500 volt continuous current supply service, and he made connection with the other side of the service by grasping an iron girder, whose edge had scraped its way through the insulator to the conductor. The current was passing for at least ten minutes.

At Sheffield the victim stood on the wet lead floor of a lavatory, one side of the 200 volt alternate current supply service being connected to "earth," and he made connection with the other side of the supply service by grasping a brass bracket inside which the supply wires ran, the sharp edge of the bracket having been forced through the insulating envelope by the victim himself in pulling the bracket down. The current was only passing through the man's body in this case for a very short time. He died probably partly from fright, caused by the shock, and partly from concussion of the brain caused by his mate pulling him violently down, so that the back of his head struck the concrete floor.

At Fulham the victims apparently made connection to earth through the water in the baths, and through the drain pipes of the bath, a large portion of their bodies being in direct connection with the water, which was warm. They made connection with the supply service, which was at 200 volts, by grasping a pipe in which the supply wires ran, the pipe being insulated from "earth," but being in connection with the conductor inside through some abrasion of the insulating envelope. The victims were in connection with the supply service for some minutes, during which the action of the heart was gradually arrested.

How to Prevent Danger.— There are two methods of avoiding similar accidents. One is by making the insulation envelopes of the supply conductors very much stronger mechanically than is at present the custom, so that they cannot be easily cut through. Electricians and wiring contractors are apt to leave this part of the problem out of account altogether, and no one troubles so long as nothing happens.

The other method is to connect all metal pipes, tubes, brackets, etc., through which supply wires run to "earth," so that no differences of pressure can possibly exist between them and "earth."

Both these methods should be applied, and we should then hear no more of accidents of the kind, even when still higher pressures rule. It is the difference of pressure between the pipe or the bracket which is grasped and the "earth" with which the victim is in connection which causes the trouble. If the pipe cannot make connection with the conductor and if the pipe is at the same pressure as the earth no current can pass and no danger follows.—London Daily Mail.

Sidney F. Walker.

ENGLISH SUGAR FARMS.

A Practical Question for 1903.

With the abolition of the sugar bounties it at once becomes possible—and therefore assured—that a new industry will arise in England. Now, for the first time, it will pay to grow sugar in England. Already some hundreds of agriculturists are only waiting for that abolition to become sugar planters on a large scale.

For it is a fact, if but little known, that, as a result of the "Daily Mail" agitation against the sugar bounties during the last few years, there has been an increasing number of sugar farmers in England. True, they have only farmed on a very small scale. They have, indeed, been mere experimenters. But by experiment they have satisfied themselves that they can grow quite as good sugar and quite as much to the acre as can be grown in Germany, France, or Russia; and that there is nothing but the protection of foreign bounties to prevent England from establishing this industry on such a scale as to be of incalculable benefit to the country.

A Restored Industry.—We allude, of course, to the cultivation of the sugar beet, and, with it, the re-establishment of that sugar-refining trade which was once so flourishing. How that trade has declined (in the face of foreign protection and home indifference) may be seen in a moment when we say that British sugar refineries have in forty years shrunk from the total of a thousand to a total of eleven!

During the last year, however, our pioneer sugar farmers have done so well, and the average of their net results is so favorable for the future, that it is clear we are on the eve of a new departure. The last year's working on many little farms scattered throughout the country and carried on by such men as Lord Denbigh, Lord Lathom, Lord Rothschild, and Colonel Everard, and by such public bodies as the Liverpool Corporation, the Hampshire Council, and the like, may be regarded as having at last demonstrated the success of the beet industry in England. For the returns of the crop prove that we have beaten the average of the Continental growers, and that there is not a county in England and Wales which could not profitably grow it.

The one thing for which the country now waits is the removal of the tax in favor of the foreigner. That will take place in a very short time. Then there will be nothing between the English farmer and a new and profitable industry, and nothing between the country and a source of new wealth.

Work for Waste Acres.— The main advantages may be summarized as increasing the national wealth; utilizing land now unprofitable; improving agriculture generally; creating a new supply of food for stock; and enormously benefiting

the working classes of the country, and, in particular, those of the now depopulated rural areas.

A glance across the Channel will give us some idea of this. Last year, for example, Germany grew sugar beets on about 1,500,000 acres; Austria-Hungary gave 1,000,000 acres to it; Russia another 1,000,000; France 900,000; and Belgium and Holland some 400,000 acres.

As a result we imported 11,870 cwt. of refined sugar from Germany, 4,340,000 from France, and 4,000,000 from Holland and Belgium, while from France and Germany alone we bought more than 7,000,000 cwt. of the unrefined article. Yet even these enormous quantities merely represent the surplus of the wealth which the sugar beet industry has created for those countries.

Now that so many hundreds of thousands of acres in England are lying practically waste, a vast increase of wealth would be at once obtained by the cultivation of sugar beet. The nature of its cultivation alone enriches the land. The deep ploughing required, the chemical manures, the intense cultivation create on the open field a system of garden culture, with the result that for all crops the land becomes much more productive. In Germany, for example, the yield per acre has so steadily increased that it is now double what it was a generation ago.

To Benefit the Working Classes.— But the most important argument in favor of establishing the sugar beet industry in England is the well-paid work it will bring to the long-suffering agricultural laborer, as well as to workmen in other industries.

As a nation we eat an enormous amount of sugar in the year—nearly two millions of tons. When the bounties are removed it will become possible to grow every bit of that sugar in England. Even if we only try to grow a quarter of it, that would lead to a great and continuous demand for labor.

How great may then be seen. If we sought to produce in time £15,000,000 worth of sugar we should require to build at least 400 factories for converting the beet into sugar. These factories would cost on the average some £50,000 apiece—a total of £20,000,000 invested in the country among the engineering, building, brickmaking and smaller trades. They would together employ 160,000 men. Then, again, the farms to keep the factories busy would find work for at least 200,000 men, and another 40,000 laborers would be required for the allied industries. That is a total of 400,000 men added to the labor class connected with agriculture and working in the country areas. They and their families would total up to 1,200,000 persons. Finally, they would draw in wages per annum not less than £16,000,000—all primarily spent, too, in the rural districts.

PROFITS OF THE SUGAR FARMS.— But is all this merely a fond hope? On the contrary, it is an accomplished fact. Sugar beet is not merely capable of being grown profitably in England, but it has been so grown during the past four or five years under a system of careful experiments.

There is the question of cost. We have the authority of Mr. S. Stein, our greatest expert in this industry, for saying that, taking it all round, the cost of rent, culture, harvesting and delivery to the factory of the sugar beet averages for the country £10 an acre, and that the value of the crop (estimated at the low figure of fifteen tons an acre and adding its by-products) would be £16 10s. an acre at present prices.

That is to say, that a small sugar farm would be profitable and a large farm very profitable.

And in addition to all this there are the profits of the factories which would arise in the midst of every beet-producing district. Into this, however, we need not go now. But it has been shown that sugar farms already exist on a small scale in this country, and that they only await the removal of the bounties—now regarded as assured—to develop indefinitely, and thus add to rural England a new and much-needed industry.

At any rate, all the experts are agreed that the industry would become so great as to be of national importance, and that the sooner it is set going on a large scale the better for the country.—London Daily Mail.

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REPORT OF EXPERT FORESTER ON HAWAIIAN FORESTS.

His Excellency Governor Dole, Honolulu: Sir: I have the honor to forward herewith my report upon the condition of the Hawaiian Islands for your consideration. During the course of my preliminary examination, I visited the Islands of Oahu, Maui, Hawaii and Molokai, and paid particular attention to investigating the rapid destruction of the forests. I feel perfectly satisfied that the indiscriminate ranging of cattle in the forests has been very largely responsible for the present conditions, and that the sure remedy will be to fence off the forests and confine the cattle to the lower slopes.

Very respectfully,

E. M. GRIFFITH,
Assistant Forester, Bureau of Forestry.
U. S. Dept. of Agriculture.

"Formerly the Hawaiian Islands were covered with dense and almost impenetrable forests which covered the steep ridges and deep canyons extending down to the narrow strip of arable land along the coasts and up to an elevation of 8,000 or 9,000 feet on the highest mountains. Ever running streams and springs occurred on all the islands and the rainfall was fairly even and much heavier than it is today.

"The old chiefs began the destruction of the forests by cutting enormous quantities of sandalwood but the blanks were soon filled up by other forest trees. The rapidity with which the native Hawaiian forest can be absolutely destroyed is truly remarkable and peculiar to the islands.

"Dense forests which were absolutely impassable have, within the short space of five or ten years, been completely wiped out, so that at the present time, the soil is covered with a thick matting of grass. This comes from the fact that all the native trees have a very shallow root system so that the least drying up of the soil immediately affects their vitality.

"In nearly all sections of the islands, the undergrowth is composed largely of a dense mass of ferns which absorbs a very large amount of moisture thus affording a most favorable protection to the soil.

"Stock, particularly cattle, are responsible for the destruction of the forests in as much as they eat and trample down the ferns and other undergrowth, thus allowing the soil to become dry and often hardened under the full force of the hot tropical sun so that the roots begin to dry up and the trees naturally die. The worst feature, however, is that as soon as the undergrowth is killed out the heavy Hilo grass immediately covers the soil and forms such a thick mat that it is impossible for seed to reach the soil and germinate. Then the life of the forest simply depends on how long the old trees can survive, for as soon as they fall the space which they occupied in the forest is taken possession of by the grasses.

"Stock also destroy many trees by stripping off the bark and by injuring the roots which they have already exposed by trampling. Another very bad feature of pasturing stock in the forests is that they eat and trample down the young trees.

"In a virgin forest where no stock have been allowed to graze, with very few exceptions, the only trees which are dying are those which would naturally do so from old age. The virgin Hawaiian forest is healthy, but where stock have destroyed the undergrowth the trees are dying in great numbers and are found to be attacked by insects particularly borers and the large girdling worms.

"Insects can readily be collected by breaking off the limb of a tree or injuring it in some other way. The forests which are being attacked by insects are those whose vitality has been affected in some way, usually by stock grazing. After inves-

tigating the matter very carefully I should say that stock are alone responsible for the rapid destruction of the forests. This is readily admitted by those who have studied the matter carefully and from an unprejudiced point of view; so that it seems essentially wrong that the welfare of the whole islands should be sacrificed to benefit the cattle business which forms such a small part of the commercial prosperity of the islands.

"With a few exceptions the forests are only valuable in conserving the water supply and increasing the rainfall. Koa and algaroba are the only two species which occur in sufficient quantities to be of any considerable commercial importance.

"Koa is a high grade cabinet wood with a very handsome grain and capable of a high polish while the algaroba furnishes the bulk of the firewood for the islands.

"The algaroba grows very well at low elevations, particularly on the leeward side of Oahu and it would pay the government to plant it on rocky or denuded areas which are unsuited to any form of agriculture.

"The chief characteristic of the native species is their small size averaging only fifteen to twenty inches in diameter and thirty to forty feet in height, together with the short length of clear bole. As a rule the side branches extend low down on the trunk which is accounted for from the fact that the trees have grown up in open stands.

"Ohia occurs far more frequently than any other specie and together with kukui, koa, mamane and hala forms the bulk of the forest, while the undergrowth is composed very largely of ferns.

"As the forests of the Hawaiian Islands contain such a very limited amount of merchantable timber, the question of the best methods of lumbering does not enter into consideration; the whole problem is conserving the water supply which depends upon the preservation of the existing forests and restocking some of the denuded slopes either by natural reproduction or planting.

"During the course of my preliminary examination the forest areas on the islands of Oahu, Maui, Hawaii and Molokai were examined, particular attention being paid to the condition of the forests along the headwaters of all streams.

"Forest protection means not only increasing the rainfall but more important still conserving the water supply. Upon the right solution of this problem depends to a very large extent the future welfare and agricultural properity of the Hawaiian Islands. Sugar, the backbone of the islands, comprising over 80 per cent of the exports is absolutely dependent upon a plentiful and constant supply of water. The planter who does not depend upon the natural rainfall but irrigates his cane is apt to think that forest protection does not directly affect his business; but in reality he should be far more solicitous about the preservation of the forest than the planter who

depends on the rainfall, for whether he is taking his water from a stream or an artesian well his supply will be very quickly affected by any disturbance of the forest cover along the important watersheds. Particularly is this the case where water is being taken from a stream whose headwaters lie within the forest belt, which is the case with most of the streams on the islands.

"Fluming cane is by far the cheapest means of transportation, for this reason to many plantations it is of vital necessity that their supply of water be at least held constant and increased if possible. The stockman or farmer and those engaged in growing rice or taro are also dependent, though not to the same extent as the sugar cane planter upon a water supply which shall be fairly constant through all seasons of the year.

"As previously stated, the denudation of the Hawaiian forests has been brought about to a very large extent by the practice of pasturing stock in the forests. Certainly this has been admitted by those who have studied the question and it is believed that fencing and the absolute exclusion of all stock is the only sure remedy. There is no necessity for abandoning the cattle business in order to protect the forests, but the cattle must be confined to the lower slopes.

"It is especially important that fences should be built along the upper limits of the forest in order to prevent the wild cattle, sheep and goats which at present are ranging on the higher grass slopes from working down into the forests.

"Wherever fences have already been built the reclamation of the forests is as surprisingly rapid as their destruction when stock are allowed to range freely. As previously stated the first effort should be to fence and protect those forests along the headwaters of all the important streams.

"In order to place the work upon a thoroughly efficient basis it will be necessary for the government, planters, ranchers and all others owning or leasing land upon which water is the chief consideration to co-operate and see to it that the forests are thoroughly protected."

"Hawaii. During the three weeks which were spent in the examination of Hawaii, I was enabled through the courtesy of the plantation and ranch managers throughout the island to visit all the districts and obtain a general idea of the conditions of the forests and what was being done to preserve them.

"In treating the forest problems of this island, the various districts will be considered in their order commencing with Hamakua.

"Hamakua. This district extends from the northern slope of Mauna Loa, north to the sea and includes the greater portion of Mauna Kea which rises to an elevation of 13,805 feet.

"During the summer of 1901, a considerable portion of the forest lying between Mauna Kea and the coast on the north was burned over very severely. There is very little question but that most of the trees in this section are so badly burned that they will die and blow down, thus furnishing fuel for succeeding forest fires. The undergrowth has been destroyed by cattle so that the fire had swept; in fact, if this had been a virgin forest with a rank undergrowth it would probably have been impossible to set it on fire. The forest had been so opened up by cattle that it died out thoroughly as is proved by the almost complete destruction of the humus so that the bare soil is now exposed. This latter result would be extremely favorable to the natural restocking of this burned area by self sown seed but, very unfortunately, cattle are grazing in the forest and will destroy any young growth which may come up.

"Within the present generation, forest fires have been almost unknown in the Hawaiian Islands but the indiscriminate pasturing of cattle in the forests makes their destruction by fire not only possible but extremely probable either through malice or carelessness in burning brush, cane trash or by camping parties.

"A large part of the burned forest is on government land which has been leased until 1906, but it is extremely important that the government should induce the lessee, by an extension of time on his cane land lease or in some other way, to absolutely exclude cattle from this forest and protect it by fencing.

"The forests in the remainder of the northern portion of the district of Hamakua are being rapidly destroyel by cattle, both wild and tame, so that the whole section within a few years will be a continuation of the Waimea plains unless adequate means are taken to protect the forests from cattle.

"The wild cattle, sheep and pigs should be driven down from the mountains and the forests preserved by fencing.

"On the north slopes of Mauna Kea, the mamani forest is spreading itself rapidly and appears to be holding out against the cattle, which is truly remarkable inasmuch as it is the only case of the kind which was seen anywhere on the islands. The mamani is a tough mountain tree and it is believed that it could be used to good advantage in restocking denuded slopes.

"Between Mauna Kea and Mauna Loa the extensive plain or table land is covered with a rather broken growth of ohia, kith scattering koa and mamani, while both mountain slopes are fairly heavily timbered.

"On the whole the forests of Hamakua are in very poor condition and in some sections fast disappearing solely on account of cattle grazing and the consequent forest fire.

"North Kohala. The Kohala mountains which extend northwest and southeast through the district were formerly covered with very dense forests which were practically impassable except by cutting a trail with cane knives. Cattle, however, have absolutely destroyed all the forests on the lower slopes and are rapidly denuding the forests on the higher slopes. In order to save any of the remaining forests, they should be fenced off and protected as soon as possible. On the lower slopes which have been absolutely denuded, artificial restoration will be necessary.

"Some of the planters in this district have fenced their forests, but concerted action on the part of the government, planters and ranchers will be necessary in order to save the water supply.

"South Kohala. The Kohala mountains extend along the northern portion of this district, but here too the forests have been very badly damaged by the cattle. The central and southern portion include the Waimea plains and the open grazing country west of Mauna Kea. On all sides of Waimea the country is a rolling plain which is unquestionably suited to agriculture and should not be covered with forests. But this fine agricultural land will be almost useless unless a constant water supply is assured and this can only be accomplished by carefully protecting the forests on the Kohala mountains, particularly north of the village of Waimea.

"At present, cattle are being run on this range and it is possible to ride through a large portion of the forest which a few years ago was impassable. Here, as elsewhere, there is no necessity for abandoning the cattle business but it should be carried on with much more system, with paddocks or an open range on the plains and the mountain forests protected from all grazing.

"Kona. This district is covered to a very large extent with lava flows a very restricted area of land suitable for any form of agriculture and no running streams of any importance. Here the need of protecting the forests is not so pressing as in many parts of the island as there are no head waters of streams to be protected and the chief value of a large area of forest land will be to increase the rainfall and maintain an equable climate.

"Here lava flows are gradually being covered with a forest growth composed chiefly of ferns and ohia which assist greatly in the rapid disintegration of the lava and the formation of a fairly rich soil. Such tracts are naturally suited to forest growth and as they are not, at present, capable of producing any more valuable crop, they should be used as forest reserves. Cattle grazing on such lands does not yield sufficient returns to justify the destruction of the young forests.

"On all parts of the island, the heaviest rains occur within the forests on the higher slopes of the mountains. Hence it

is extremely important that the forest growth should be encouraged on Hualalai and the existing forests protected.

"The combined area of the rocky slopes and the lava flows is considerable and the territorial government should see to it that these sections are kept under forests as they are almost worthless for any other purpose. Provided such a definite policy is adopted, it would be entirely safe to permit the clearing of all forest land for agriculture within the district.

"Kau. Formerly this was considered the driest district on the island of Hawaii, but since the plantations and ranches have commenced to preserve the forests by means of fencing out the cattle, the rainfall has increased materially.

"Great credit is due the gentlemen who have been so far sighted and liberal thus preserving a magnificent stretch of forest. Over thirty-one miles of protection fence have been built on the slopes of Mauna Loa back of the Pahala plantation and ranch, and within five years, since the fence has been constructed, the young growth, composed for the most part of ferns and ohia, has come up in such dense masses that it is almost impassable and the land is rapidly regaining its marshy character. This very satisfactory reclamation of a large forest belt which has been severely thinned out by both wild and tame cattle within a few years speaks for itself and points out the way both for the government corporations and private owners who are all vitally interested in preserving the water supply.

"Within the district, also notably, in the vicinity of the crater of Kilauea, are large tracts of land covered with lava and upon which the young forest growth which is struggling to gain a foothold and make soil should be absolutely protected. The growth of all species which are easily self sown, particularly the pines should be encouraged. This is especially true on the mountain slopes and higher elevation where it is important to conserve the heavy rainfall which, at present, is very largely lost through the rapid evaporation on soil which is exposed to the full force of the sun's rays.

"Puna. Puna is called the tropical district of the island and contains the truly magnificent forests of Olaa which are composed very largely of tree ferns which grow to a height of from thirty to forty feet with a mass of smaller ferns as an undergrowth. In this connection the fact should be emphasized that a dense of ferns conserves the water more completely and gives it off more gradually than a more open forest of native trees. The ferns act as a sponge, absorbing an enormous amount of moisture and giving it off very gradually, especially if the ferns are in dense shade from an overhead or second-storied forest of trees.

"Puna has a vast forest area and while large tracts are being cleared for homesteads, yet it is probable that there will be no dimunition of the rainfall or water supply for flum-

ing or irrigating provided the upper slopes of the forest are protected.

"Hilo. This district contains nearly all the running streams on the island of Hawaii and it is therefore more important to protect the forests on the head waters of these streams than in nearly all other sections combined. Most of these streams come from underground water which rises to the surface at a comparatively low elevation and are used extensively for fluming cane along the line of plantations which extend from Hilo to Hamakua. The loss or decrease in flow of these streams would be a severe blow to the plantations as they depend on fluming almost exclusively for the transportation of their cane to the mill. Above the plantations, the extensive forest covered slopes of Mauna Kea produce a very heavy rainfall which sweeps through the aa flows and is carried to the lower levels by the more or less solid pahoehoe.

"The lower edge of the forest is protected by the cane lands but wild and tame cattle, sheep and goats are killing the forest along the upper slopes and so gradually narrowing the forest belt. The rains which fall on the higher grass covered slopes and which is not lost by evaporation runs off very rapidly thus causing the small streams to overflow their banks after a very heavy rain without conserving any of it for the drier season when it is most needed.

"Nearly all of this government land has been leased for a long terms of years and the plantations in order to protect the headwaters of the streams must fence along the upper forest slopes and drive out or kill the stock which remains below the fence.

"The government should assist the plantations in every possible way to protect the forests and incorporate in all future leases a provision that all important forests areas shall either be fenced by the lessee or all cattle absolutely excluded.

"Maui. The forests on the island of Maui, upon the whole, are in a fairly satisfactory condition although in certain sections they are diasappearing very rapidly. Nearly all the sugar plantations and the bulk of the arable land lies between Wailuku and Honomanu and here the forests have been seriously injured by stock grazing.

"The sugar planters and farmers in this locailty all depend upon irrigation, the water being taken from small streams which for the most part rise on the slopes of Haleakala. For many years, cattle were allowed an unrestricted range in the forests along the headwaters of these streams so that in many sections the forest is either dead or dying.

"The almost total destruction of the undergrowth has allowed the soil to bake and harden thus causing the rainfall to run off rapidly with the resultant effect of very low water during the dry season. The Haiku and Spreckelsville ditches have prevented stock from ranging in the upper forests and

so have formed a protection belt from Haiku to Honomanu. Along the line of the Haiku ditch the almost total destruction of the forests by stock is clearly shown; for whereas the forests on the upper side of the ditch, which have been protected, are very dense and healthy, those on the lower side, which have been open to grazing, are either almost destroyed or in a very unhealthy condition.

"The district of Kula is also a striking example and in order to save the little remaining forest, the cattle must be absolutely excluded. It is far easier and a much better policy to save the existing forests than to certainly destroy them by grazing and attempt to realize by planting a forest in some other locality.

"Planting is extremely expensive, especially if the trees are set out very close together as must be done if a dense forest is to be secured which will act as a sponge and hold the water supply. Then too, a small amount of planting here and there does very little good and such expensive work will seldom be necessary in the islands if a common sense forest policy is pursued.

"The government owns some very important forest areas on Maui along the headwaters of the streams and the upper slopes of the mountains which should be segregated and set aside as forest reserves. It will probably be advisable to build fences and necessary to make a detailed examination in order to determine which lands are suitable for agriculture and those which should always be kept under timber.

"The forests in the Iao valley are very well protected and consequently show no signs of deterioration while the streams are maintained with a fairly even flow. The forests in the remainder of the district of Lahaina show very plainly the effect of grazing and must be much more carefully looked after in order to conserve the all important water supply.

"The whole question on the island of Maui is protecting the existing forests; it is of the most vital importance to the plantations that these should be done at once and thus save the very large expense of artificial planting.

"Molokai. Cattle, goats and deer have totally destroyed the forests upon the larger portion of the island of Molokai so that the western half is practically destitute of any tree growth. It is possible that the algeroba forests which have secured such a stronghold along the coast near Kauanakai may gradually spread over this end of the island. At present the soil is covered with a thin growth of grass which is apt to die down during the dry season thus allowing the top soil to cake and powder.

" Molokai is exposed to the full force of very heavy winds which are rapidly blowing most of this fine soil top soil off into the ocean. The algeroba will hold this soil, furnish splen-

did firewood and the bean pods make a very good feed for cattle during the dry season.

"Planting in belts or strips is recommended on the western half of the island in order to form wind breaks and thus hold the shifting soils. The eastern half of the island including the entire Olokui section is by far the most important for here all the streams rise.

"Cattle and deer, particularly the later have destroyed a large area of the forests but within late years their numbers have been greatly reduced by hunters who have been paid to shoot them.

"The condition, at present time, is that the forest has been pushed back into the deeper and more inaccessible canyons and onto the highest slopes of the mountain. The effective watershed in respect to the conservation of the water supply has thus been greatly reduced and the careful protection of the remaining forests is an absolute necessity.

"A small amount of fencing has already been done and the results are surprisingly satisfactory although the forests had been very badly denuded. The remaining fences should be constructed at once while there is still a small amount of undergrowth which will assist very materially in the rapid reclamation of the forests.

"Oahu. Forest protection on Oahu is far more important than on any other island of the Hawaian group on account of the large interests at stake and the great value of the water supply. Probably there is a greater daily consumption of water for irrigation purposes between Honolulu and Kahuku than on any equal area in the United States. The sugar plantations alone pump over 314,000,000 gallons of water daily.

"Both the Waianae and Koolau ranges were formerly covered with a heavy forest growth extending down nearly to the shore line and in the center to the Waialua plains. But the indiscriminate ranging of cattle has resulted in the total destruction of all the undergrowth and trees on the lower slopes so that today the remaining forests are confined to the upper slopes and the more inaccessible canyons. Still the cattle continue to rapidly destroy the forests although in many cases the land and cattle owners are far more financially concerned in the welfare of the sugar plantations.

"The water which is being pumped by the plantations to irrigate their cane is very largely that which falls within the forests belt on the higher slopes and gradually sinks to the artesian level. Consequently if the cattle and goats are allowed to destroy these forests, a considerable amount of water will be lost through largely increased evaporation on the exposed soil and the rapid run off.

"There is a large amount of natural grazing land such as the Waialua plains and the lower slopes of the two ranges above the cane lands so that the necessary protection of the forest

areas does not mean doing away with the cattle business. There is also a large amount of fine agricultural land on the Waialua plains but these will be absolutely worthless unless the water supply is protected.

"The reforestation of Tantalus by the Department of Agriculture and Forestry is an unusually fine piece of work very successfully carried out but it clearly demonstrates how difficult and expensive the reclamation of such land becomes when all forest growth has been destroyed. It emphasizes the fact of how much easier it is to fence and protect the forests in time while a few trees remain to seed up the surrounding soil than it is to delay until artificial reforestation is necessary.

"If the lower slopes of the forests on the Waianae and Koolau ranges are fenced off as soon as possible, the scattering trees will gradually reforest the slopes, the young koa, which at present is being eaten off and tramped by cattle, will come up and a small amount of planting of those areas which are absolutely denuded will be necessary. The fencing should have been done long ago and at present the reclamation of the forests will be very slow on account of the few seeds which remain and the mass of Hilo grass which has covered the soil and makes reproduction very difficult if not impossible.

"So much of the government land on this island has been leased for a long term of years that the effective protection of the remaining forests depend upon the planters and other lessees will be benefitted. However, it is hoped that the government can assist in building the fences and they will appoint a ranger to patrol the forest lands not under lease and see to it that all cattle are excluded.

"In future the forest areas on this island should never be leased for grazing purposes and the lessees of cane and agricultural lands should be obliged by the terms of their lease, to build stock fences and keep them in repair.

"Recommendation for the organization of a Forest Force. In order to thoroughly protect the forest areas and carry out the forest policy of the government, the organization of a field force is extremely important. The following forest force which is similar to those in charge of the forest reserves in the United States is recommended, viz: A forest inspector who shall be a practical forester and have charge of all government forest land and direct the work of the forest rangers. Four Forest Rangers who shall have had some practical training in forestry, understand lumbering and tree planting, with ranges as follows: One on the island of Oahu; one on the island of Hawaii; one on the island of Kauai; one for the islands of Maui and Molokai.

"Their duties should consist in patrolling all government forest land within their ranges and enforcing the terms of the

lease, superintending the construction of all government fences, acting as fire wardens and taking charge of all the planting.

"If thoroughly competent men are appointed, such a force should prove wonderfully efficient in protecting and building up the forest reserves."

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THE SUGAR CANE BORER.

(DIATRAEA SACCHARALIS).

(Condensed from a Report by William C. Stuggs).

(Continued from our last number).

Again, the power of flight in the moth is very limited, and hence the area of infection may remain local for some time. On account of this feebleness of flight, the moth, while existing in small numbers, confine their attacks to the ends of the rows and to the ditch-bank rows. When they begin to multiply, they penetrate deeper into the cane, and the moth that emerges from the pupa in the interior of the field, lays its eggs in the immediate vicinity of its birth. Sometimes they are borne by the prevailing winds of distant fields, and since our winds in summer are mainly from the South and West, one would expect the progress made by the borer would be Northward or Eastward. No such progress has been reported.

Again, when the moths are comparatively few, they select the tenderest cane upon which to deposit their eggs. Canes, therefore, which are succulent and tender from any cause, either by cultivation, by fertilization, or by inheritance (varieties), will attract the borer when in numbers sufficiently large to be disseminated over the field and sufficiently small to be allowed the privilege of selection. When existing in destructive numbers this privilege of selection is greatly abridged. Hence white cane is more subject to attack than our purple or striped, plant cane more than stubble, fertilized cane more than unfertilized, well cultivated canes more than grassy ones, green, succulent canes more than short, pithy ones, canes on sandy loams more than those on stiff black soils, the upper and tenderest parts of the stalk in preference to the lower harder portion. The eggs are believed to be laid upon the green leaves, and the young worm on hatching descends the leaf to the stalk, and after eating for some days the parenchyma of the leaves and the outer cuticle of the stalk enters the latter and begins his destructive work. Hence, in all of the year, the borer will generally be found in the upper part

of the stalk, and if he is not sent to the mill, may be laid away in the lower portion of the top which is left in the field. Therefore, burning the tops should be thoroughly accomplished to destroy every possible borer that may be present.

In cutting cane the tops can be advantageously laid upon the tops of the rows, rather than in the middles, as now usually practiced. In this position they would prevent the immediate germination of the stubble (a most desirable consummation), would dry out quicker and could be more easily and completely burnt. With the tops thrown into the middles, it is difficult, if not impossible, to completely burn them, as they lie.

If fall planting only be made, using for seed cane stripped as you would for the mill, and planted sufficiently late to prevent germination in the fall and covered with three to four inches of dirt, the enclosed borers must remain until the cane is scraped in the spring, and the few which will then escape would be hardly enough to produce much harm during the summer. If to this is to be added the complete destruction by burning of all the tops and cane trash, it is hard to conceive a way and manner in which the borer could survive the winter in quantities sufficient during the summer. If the planter should delay the planting of such crops as corn and sorghum until April, it is more difficult to conceive of a suitable plant upon which the borer, should he escape from the fall planted canes, could deposit its eggs.

The remedies suggested, if rigidly applied, will most assuredly reduce the number of borers with us to an inappreciably harmless quantity. No sugar country is more fortunately situated for the successful combat against sugar cane insects than Louisiana. Our winters, which sometimes bring disaster to our harvests, are at least favorable to the destruction of tropical insects, and if advantage be taken of our knowledge of the life history of this pest and an intelligent co-operation with nature be effected by all the sugar planters of the State, the sugar cane borer would ultimately be exterminated in this State.

Many of the remedial measures to be adopted in the suppression of the sugar cane borer have been discussed under the sources of borer infection, but a recapitulation is here made, together with remedies not embraced in foregoing discussion.

Fall planting should be more generally practiced until the borer is either eradicated, or its attack reduced to a minimum.

The windrowed areas should be systematically gleaned after removal of cane for spring planting, and all pieces of cane destroyed by fire or carefully buried. No cane should be allowed to drop from the carts or cars in transit, and all cane

on the spring planted areas should be buried deep enough to prevent the escape of the moths.

Corn or succession cane should not be planted on windrowed ground until all borers are eradicated. In fact, to avoid the greatest danger no corn should be grown on cuts previously devoted to cane in which borers existed. After realizing the attack of the borer on corn, many planters will abandon the cultivation of corn until the plantation is freed from borers.

The growth of shoots and suckers from the stubble of early cut cane should be prevented by covering the stubble with the tops, or the stubble should be shaved in the fall and covered with earth. Wherever these shoots and suckers appear they should be cut down to the ground before frost, in order to catch the young borers in the tops of the shoots. The borers will not leave the shoots, but perish as their food disappears, by withering and decay.

All trash (cane tops) should, when cut, be so arranged upon the cane rows as to hasten drying, and hwenever dry should be fired. Delay often compels the burning of tops under favorable conditions, thus giving the borers in them ample food to reach maturity. The fragments of tops remaining after firing should be pulled to the centre of the row and buried by off-barring before the first of March, thus preventing the escape of moths, the majority of which (of the hibernating brood) emerge from March 15th to April 15th. Not permitting any trash to remain unburned or unburied, being careful to pick up all stocks lying along the road, turn rows and car tracks, the removal of all trash from the cars and from around the mill will, with clean field culture, reduce the attack of the borer beyond appreciable injury, if not eradicate this pest from the plantations of the State.

Borer infested cane brought to a refinery located in a borer free section, has undoubtedly been the medium of infection in some sections. As the manufacturer is equally interested in the production of sound cane, all trash in cars and around refineries should be carefully destroyed.

In introducing new varieties of cane, care should be exercised to select borer-free stalks. In case this is impossible, fall planting of all new importations should be adopted.

The permitting of employees to carry infected cane from one place to another should be discouraged. It has been found that in towns where sugar cane is offered for sale, that borer infected pieces are frequently thrown out i nthe back yards, where the following spring the moths escape and deposit eggs upon sweet corn. The attack of the sugar cane borer on sweet corn planted in isolated gardens, has in several instances been traced to the purchase by some member of the family, of borer infected cane of the previous fall.

NATURAL ENEMIES OF THE BORER.—Up to the present time we have not found any practical means of artificially increasing the natural enemies of the sugar cane borer (i. e. those found indigenous to the State). For this reason we do not regard it advisable in this discussion to do more than mention a few of the more important forms which were observed to feed upon the borer in one or more stages of its existence.

All of the natural enemies are predatory in their habits except the single fungus which lived and developed parasitically upon the borer caterpillars.

In Bulletin No. 9, Second Series of the Louisiana State Experiment Station, mention is made of a small black larva which entered the burrows and fed vigorously upon the borers. At the time that this bulletin was issued this enemy of the borer was thought to be the larva of a Lampyrid beetle (Chauligonathus Pennyslvanicus) but recent observations have shown it to be the larva of Chauliognathus marginatus, a beetle much more common in sugar cane and corn plantations of Louisiana. Chauliognathus Pennyslvanicus does occur in Middle and Northern Louisiana, but is much less abundant.

Upon every plantation visited the larva and adults of Chauliognathus marginatus were found. In the larval condition this insect is shy and if upon the stalk when disturbed, drops to the ground and instantly hides at the roots of the plant.

Many planters have observed this insect at work upon the borer and appreciate its presence in the State.

From many plantations we have received specimens of the larva of another beetle which has been found feeding upon borers in suckers and in windrowed cane. This insect is a "wire worm," the larval stage of a common "click" or "snapping" beetle (Drasterius elegans.) In cages the "wire worms" ate, on an average, two borers apiece per day, and gave every evidence of being a decided enemy to the sugar borer.

These larva are well distributed throughout the State and have no doubt been of much assistance in preventing even greater losses from the ravages of the borer.

Two species of ants were found to attack the eggs and moths of the borer. We are unable at present to give any exact data as to the value of these species in the control of this pest.

Upon the Sugar Experiment Station, Mr. Robt. Glenk found, January, 1901, a few borers covered with a white fungus. Experiments were made with this disease to prove its infecting power, with very satisfactory results. Experiments are now in progress testing the value of artificial inoculation with pure cultures of this disease, the results of which will be given in full to the planters of the State at some future time.

INTRODUCTION OF BIRDS INTO HAWAII.

The Rice bird, California House-finch and Mina were introduced many years ago, being numerous and widely distributed over the islands in 1892, when I came to the Islands. At that time the Mina was less ubiquitious than the others, but it has since occupied those districts from which it was then absent, and excepting a few parts of very dense forest is now to be found about everywhere, both on the open lowlands and in the forest belt. It is safe to say that these imported species far outnumber in individuals all the native land birds taken together.

The introduction of the Rice bird and linnet is quite inexcusable for the damage they do is out of all proportion to the good. With rice the second important agricultural industry of the Islands you can easily judge of the folly of importing these birds, both of which form enormous flocks, so that the rice crop in most parts can only be saved by constant watching, and the discharge of much ammunition. The California house-finch is also a fruit-eater and in places does considerable damage in this respect.

The Mina on the other hand is a very large insect eater and destroys many injurious kinds as well as some of the highly important (introduced) beneficial ones. It is partial to many kinds of fruit and does considerable damage in this respect. It has been the chief agent in the spread of the lantana over miles of country, since the aromatic berries are one of its favorite foods. In this however it is assisted by other imported birds, the dove, pheasants and other game birds, which are also extremely fond of these berries. Mr. Albert Koebele, the great Territorial Entomologist is now on a mission to find enemies for the destruction of the lantana. Should he be successful it is I think certain that the Mina will exact a far heavier toll on the cultivated fruits than it now does. The Mina as I have elsewhere shown also interferes with the native forest birds, and is a devourer of both eggs and young of other species. The native Passeres are of extreme economic importance in the forests, because they have developed *pari passu* with the insects and on account of the peculiar habits of the latter, fill a place, which it is not likely any foreign (introduced) species would occupy. The Mina when feeding in the open grass lands, as it sometimes does in enormous flocks, is very beneficial. It does work in this situation which formerly fell almost entirely to the migratory golden plover. The latter, partly owing to the increased area of cultivation, and partly to the fact that it is year after year shot in great numbers by the sportsmen is much less numerous in most parts of the islands than it used to be. It is an extremely valuable bird economically, destroying caterpillars of various Noctuae (cut worms) in enormous quantities and also the moths themselves. In some places the mina occupies the position largely vacated by the plover, the

latter visiting the islands only during those months when as a rule the caterpillars are most numerous. The introduction of reptiles (i. e. the prevention of it,) is of less importance than the introduction of noxious birds and, as was the case with the former so also now with the latter there appears to be no law by which any American bird can be kept out of the Territory.

It is quite certain that no man who has not an intimate knowledge of the insect fauna here as well as of the native birds and their habits, and the interdependence of one upon the other, should be permitted to make any such introduction, and even for such a man the utmost caution and careful consideration would be necessary.

As an instance of this I may mention the attempt that is or was being made to import wood-peckers into these islands. To any one with a rudimentary knowledge of the insect fauna it is obvious that the most abundant and easily obtained food for these birds would be the larvae and pupae of the native wasps, which are placed in the dead branches and trunks of forest trees, at no great depth and easily accessible to such a bird. They are readily eaten if given to introduced birds but form no part of the food of the native kinds. There are 100 species of these wasps known and they exist on all the islands and at all seasons in millions of individuals, and all the species are absolutely peculiar to these islands.

A week's survey of a single gulch and its branches enabled me to reckon the probable number of individuals of one species alone of these wasps in this gulch as not less than a million, and several other species were present in greater or less numbers. Allowing two months for each generation the enormous number of caterpillars destroyed is evident, since the wasps are numerous at all seasons of the year. Each wasp is bred at the expense of from four to a dozen caterpillars, and these caterpillars are mostly of kinds inaccessible to birds, but for obtaining which the wasps are specially constructed. They supplement the work of the native caterpillar —eating birds and such plagues of caterpillars as exist in the forests are certainly largely due to the decrease of these birds. It is safe to say that any introduced birds which took to feeding on and largely destroying these wasps, would bring on such a destruction of both forest and pasture land as is not conceived of by those who talk glibly of introducing this, that and the other species. Other cases of a similar nature could easily be cited of the close relationship of various parts of this highly peculiar fauna, and of fauna and flora.

If the Department would obtain a prohibition against the importation of birds into these islands from the mainland except after a consultation of the Territorial Entomologist, Mr. Albert Koebele, (himself familiar with insects and fauna of these islands) with the Washington Department, they would confer a still greater benefit on the islands than they have already done.

June 7, 1902. R. C. L. Perkins.